
Transmission considerations

Echo

All voice connections between telephones require two directions of transmission for conversation to take place. When the signal transmitted in one direction is reflected over the other directional path, the caller hears the caller's own voice, with a slight delay.

Depending on the delay, the effect is perceived as sidetone, rain barrel effect, or echo. Two-wire facilities require care in matching impedances to prevent reflections. Four-wire facilities do not generate reflections. But they do not eliminate the reflection problem in built-up connections, because there are, in most cases, 2-wire connections to the telephones.

The objection to echo increases with the echo delay. The via net loss (VNL) plan provides an increasing loss depending on delay. However, the loss also reduces the received volume. Limits are placed on the amount of loss used to suppress echo. If these limits are exceeded, use echo suppressor devices instead.

Loss

The provision of good transmission requires the following compromises:

- sufficiently low (one-way) loss in each direction to provide satisfactorily high received volumes
- minimum contrast in received volumes on different calls
- sufficiently high round-trip losses to ensure adequate performance from the standpoint of suppressing talker echo, noise, and near-singing

The following loss plan has been developed for the Electronic Switched Network (ESN). The network is partitioned into node-to-node connections, node-to-main connections and main-to-satellite or tributary connections. The plan requires that

- node-to-node trunks have a maximum loss of 3.5 dB
- node-to-node tandem connections have a maximum loss of 4.1 dB
- node-to-main trunks have a maximum loss of 2.5 dB

You can meet these loss objectives by installing echo suppressors and reducing the loss to 0 dB on trunks when the objective loss is exceeded with VNL alone.

Tandem switching

Public network tandem switching

A public network tandem switch is usually collocated with the carrier facilities that serve the switch. You can make tandem connections between trunks terminating at this switch without significant degradation of transmission performance.

PBX network tandem switching

A PBX network tandem switch is usually located on customer premises, remote from the carrier facilities that serve the PBX switch. These carrier facilities are generally located at a telephone company (telco) switching center and connected to the PBX switch by local loop plant (cable). If the telco switching center does not have long-haul carrier facilities, short-haul carrier facilities are used to connect to another telco switching center that has these facilities. Thus, a tandem connection made at the PBX switch can introduce the distortion of two loop plant connections and two carrier facility connections, both avoided in the public network tandem connections.

Trunk routing rules

Trunk routing rules define the allowed connections between node, main, tributary, and satellite PBX switches. These routing rules are summarized in [Table 1](#).

Table 1
Trunk routing rules

To: From:	Node	Main	Tributary	Satellite
Node	Yes (up to 4 links)	Yes (Note 4)	No (Note 3)	No (Note 3)
Main	Yes (one node only)	No (Note 1)	Yes (one main only)	Yes (one main only)
Tributary	No (Note 3)	Yes (one main only)	No (Note 2)	No (Note 2)
Satellite	No (Note 3)	Yes (one main only)	No (Note 2)	No (Note 2)

Note 1: Permitted for non-tandem trunks if the connected main PBX switches are part of a coordinated dialing plan. Also, routes of this type already in place when ESN is installed may be allowed to remain. However, these routes should be eliminated as part of network evolution to support the dialing plan.

Note 2: Routes of this type already in place when ESN is installed may be allowed to remain. These routes should be eliminated as the network evolves.

Note 3: This route is permitted by upgrading the tributary or satellite switch to main switch capabilities.

Note 4: One-way routes from nodes to main PBX switches are not restricted.